

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): John Wilkes et al.

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Application No.: 09/641,383

Examiner: Inoa M.

Filing Date: 8-17-2000

Group Art Unit: 2188

Title: EXCLUSIVE CACHING IN COMPUTER SYSTEMS

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TRANSMITTAL OF APPEAL BRIEF

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Transmitted herewith in **triplicate** is the Appeal Brief in this application with respect to the Notice of Appeal filed on 4-29-04.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) \$330.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

() (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

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() The extension fee has already been filled in this application.

(X) (b) Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

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Respectfully submitted,

John Wilkes et al.

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In Re Application of:

John Wilkes et al.

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For: EXCLUSIVE CACHING
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Paul H. Horstmann

Signature

6-29-04

Date

Appellant's Brief (Pursuant to 37 C.F.R. §1.192)

Dear Sir:

Applicant/ Appellant submits this Appeal Brief in connection with the above-referenced patent application which is on appeal to the Board of Patent Appeals and Interferences.

07/08/2004 RHEBRAHT 00000035 082025 09641383

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REAL PARTY IN INTEREST

The real party in interest in this application is Hewlett-Packard Development Company, L.P.

RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any other related appeals or interferences that may directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF THE CLAIMS

Claims 20-24, 27-31, 36, and 38 stand rejected under 35 U.S.C. §102(b) as being unpatentable over U.S. Patent No. 5,933,853 of *Takagi* ("*Takagi*").

Claim 37 stands rejected under 35 U.S.C. §103(a) as being unpatentable over *Takagi* and U.S. Patent No. 6,243,795 of *Yang et al.* ("*Yang*").

Claims 25-26 and 32-33 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Takagi* and U.S. Patent No. 6,253,290 of *Nakamoto* ("*Nakamoto*").

Claims 34-35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Takagi* and U.S. Patent No. 6,324,632 of *McIntosh-Smith* ("*McIntosh-Smith*").

Appellant appeals the rejection of all of the pending claims 20-38. Claims 20-38 as currently pending are set forth in the attached Appendix.

STATUS OF AMENDMENTS

Appellant is unaware of any amendments filed after the Final Office Action mailed January 29, 2004 which finally rejected claims 20-38.

SUMMARY OF THE INVENTION

Claims 20-38 are directed to exclusive caching of a set of information in a storage system cache of a storage system and a host cache of a host system such that duplicate copies of the information do not accumulate in the host and storage system caches. (Page 3, lines 1-10 of Appellant's Specification). Exclusive caching according to claims 20-38 includes providing the host system with access to the information by reading the information from the storage system cache and then storing the information in the host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches. (Page 6, lines 1-27 of Appellant's Specification). Exclusive caching according to claims 20-38 also includes demoting the information from the host cache to the storage system cache if the information is clean when evicted from the host cache. (Figures 2 and 3 of Appellant's Specification). The initial eviction of the information from the storage system cache when it is placed into the host cache and the eventual demotion of that information from the host cache to the storage system cache avoids the creation of duplicate copies of the information in the host cache and the storage system cache. (Page 7, lines 13-17 of Appellant's Specification).

ISSUES PRESENTED

I: Whether claims 20-24, 27-31, 36, and 38 are anticipated by *Takagi*.

II: Whether claim 37 is obvious in view of *Takagi* and *Yang*.

III: Whether claims 25-26 and 32-33 are obvious in view of *Takagi* and *Nakamoto*.

IV: Whether claims 34-35 are obvious in view of *Takagi* and *McIntosh-Smith*.

GROUPING OF CLAIMS

Claims 20-38 stand together (Group I).

ARGUMENT

I: Claims 20-24, 27-31, 36, and 38 are not anticipated by *Takagi* because *Takagi* does not disclose the limitations of claims 20 and 27.

Appellant respectfully submits that claims 20 and 27, and claims 21-24 and 28-31, 36, and 38 which depend from claims 20 and 27, are not anticipated by *Takagi* because *Takagi* does not disclose exclusive caching of a set of information such that duplicate copies of the information do not accumulate in a host and a storage system cache as claimed in claims 20 and 27. *Takagi* does not disclose providing a host system with access to the information by reading the information from the storage system cache and storing the information in the host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches as claimed in claims 20 and 27. Furthermore, *Takagi* does not disclose demoting the information from the host cache to the storage system cache if the information is clean when evicted from the host cache as claimed in claims 20 and 27.

A. *Takagi* does not disclose providing a host system with access to a set of information by reading the information from a storage system cache and storing the information in a host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches as claimed in claims 20 and 27.

Appellant submits that *Takagi* does not disclose providing a host system with access to a set of information by reading the information from a storage system cache and storing the information in a host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches as claimed in claims 20 and 27. Instead, *Takagi* teaches providing access to a logical block of data by reading the data from a storage system cache, a cache HDD 5 disk cache (*Takagi*, col. 4, lines 34-36), and storing the data in a host cache, a high level cache memory 4 (*Takagi*, col. 4, lines 31-33), such that the information

occupies space in both the high level cache memory 4 and the cache HDD 5 (*Takagi*, col. 9, lines 24-54).

For example, in describing a process of reading a logical block of data *Takagi* teaches that

When the specified logical block does not exist in the cache memory 4,...an empty block is secured in the cache memory 4..., thereby obtaining a cache memory block (CBN).

(*Takagi*, col. 9, lines 34-38) and that

Then, the cache HDD block management table 36 is searched to check to see if the specified logical block exists in the cache HDD 5. If it exists, the data is read from the cache HDD block (HBN) in the cache HDD 5 and stored in the cache memory block (CBN).

(*Takagi*, col. 9, lines 39-43).

Thus, *Takagi* reads a logical block of data from the cache HDD 5 and stores it in the cache memory 4 but does not teach that the logical block of data is evicted from the cache HDD 5 after being stored in the cache memory 4. As a consequence, the same logical block of data clutters up both the cache HDD 5 and the cache memory 4 in the system of *Takagi*. In contrast, the exclusive caching of claims 20 and 27 avoids cluttering both a storage system cache and a host cache with the same block of information by evicting the information from the storage system cache after it is moved to the host cache.

The Examiner has stated that

In *Takagi*'s system dirty data is being staged out from the cache memory 4 to the HDD cache 5; where "staging out" involves moving data out from the cache memory 4 and writing it into HDD cache 5 ("evicting information from the storage system cache such that the information does not occupy space in both the host and storage system cache",¹ Column 5, Lines 22-25).

(Page 2, Office Action, January 29, 2004). (emphasis original).

Appellant submits that any teaching in *Takagi* of staging out data from the cache memory 4 to the HDD cache 5 does not anticipate the limitation in claims 20 and 27 of evicting a set of information from a storage system cache

¹ Appellant submits that the emphasized parenthetical text set forth by the Examiner is an assertion that the teaching in *Takagi* of staging out data from the cache memory 4 to the HDD cache 5 anticipates the limitation in claims 20 and 27 of evicting a set of information from a storage system cache when it is moved to a host cache.

when the information has been read from the storage system cache and stored into a host cache. The staging out taught by *Takagi* is transferring data from the cache memory 4 to the HDD cache 5 (*Takagi*, col. 5, lines 22-25), i.e. from a host cache to a storage system cache, rather than evicting a set of information from a storage system cache as claimed in claims 20 and 27.

B. Takagi does not disclose demoting a set of information from a host cache to a storage system cache if the information is clean when evicted from the host cache as claimed in claims 20 and 27.

Appellant submits that *Takagi* does not disclose demoting a set of information from a host cache to a storage system cache if the information is clean when evicted from the host cache as claimed in claims 20 and 27. Instead, *Takagi* teaches discarding data evicted from a host cache if it is clean when evicted. (*Takagi*, col. 5, lines 22-29). *Takagi* states that

In staging out data from the cache memory 4 to the cache HDD 5, only when the data is dirty or highly-frequently accessed and not stored in a highly-frequently accessed optical disc 24², it is written to the cache HDD 5. In other cases, writing is not effected and the data is just discarded. (*Takagi*, col. 5, lines 22-29) (emphasis added) and that

By doing this, the cache HDD 5 stores dirty data items or only such data items as are newly turned into highly-frequently accessed data items and have not been allocated to a highly-frequently accessed optical disc 24. The data already allocated to a highly-frequently accessed optical disc 24 is not written to the cache HDD 5.³ (*Takagi*, col. 5, lines 43-48). In contrast, the exclusive caching of claims 20 and 27 demotes all clean information evicted from the host cache to the storage system cache without regard to its frequency of access or where it is stored on physical media in the storage system.

² The storage media of *Takagi* consists of a set of optical discs 24 that are divided into discs that store highly-frequently accessed data and discs that store less-frequently accessed data. (*Takagi*, col. 5, lines 15-21).

³ Appellant submits that the handling of data from the cache memory 4 that is highly-frequently accessed as taught by *Takagi* is intended to reduce the number of changes of the optical discs 24 (*Takagi*, col. 5, lines 51-55) rather than provide exclusive caching between a host cache and a storage system cache as claimed in claims 20 and 27.

II: Claim 37 is not obvious in view of *Takagi* and *Yang* because *Takagi* and *Yang* do not disclose or suggest the limitations of claim 27.

Appellant respectfully submits that claim 37, which depends from claim 27, is not obvious in view of *Takagi* and *Yang* because *Takagi* and *Yang* do not disclose or suggest exclusive caching of a set of information such that duplicate copies of the information do not accumulate in a host and a storage system cache as claimed in claim 27. Appellant has shown that *Takagi* teaches reading data from a cache HDD 5 and storing the data in a cache memory 4 such that the data occupies space in both the cache memory 4 and the cache HDD 5 (*Takagi*, col. 9, lines 24-54).

Yang does not disclose or suggest reading a set of information from a storage system cache and storing the information in a host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches as claimed in claim 27. *Yang* discloses a CPU 12 that reads data from a cache in a storage system (*Yang*, col. 5, lines 16-19) but does not teach that the read data is evicted from the cache in the storage system as claimed in claim 27. Moreover, *Yang* does not disclose or suggest demoting a set of information from a host cache to a storage system cache if the information is clean when evicted from the host cache as claimed in claim 27. Instead, the storage system cache of *Yang* discards evicted data when it is clean. (*Yang*, col. 4, lines 32-34).

III: Claims 25-26 and 32-33 are not obvious in view of *Takagi* and *Nakamoto* because *Takagi* and *Nakamoto* do not disclose or suggest the limitations of claims 20 and 27.

Appellant respectfully submits that claims 25-26 and 32-33, which depend from claims 20 and 27, are not obvious in view of *Takagi* and *Nakamoto* because *Takagi* and *Nakamoto* do not disclose or suggest exclusive caching of a set of information such that duplicate copies of the information do not accumulate in a host and a storage system cache as claimed in claims 20 and 27. Appellant has shown that *Takagi* teaches reading data from a cache HDD 5 and storing the data in a cache memory such that the data occupies space in both the cache memory 4 and the cache HDD 5 (*Takagi*, col. 9, lines 24-54). *Nakamoto* discloses a multi-processor system that avoids write monitoring of a cache (*Nakamoto*, col. 3, lines 60-65) rather than exclusive caching of a set of information such that the information does not occupy space in both host and storage system caches as claimed in claims 20 and 27.

IV: Claims 34-35 are not obvious in view of *Takagi* and *McIntosh-Smith* because *Takagi* and *McIntosh-Smith* do not disclose or suggest the limitations of claim 27.

Appellant respectfully submits that claims 34-35, which depend from claim 27, are not obvious in view of *Takagi* and *McIntosh-Smith* because *Takagi* and *McIntosh-Smith* do not disclose or suggest exclusive caching of a set of information such that duplicate copies of the information do not accumulate in a host and a storage system cache as claimed in claim 27. Appellant has shown that *Takagi* does not disclose or suggest exclusive caching of a set of information such that duplicate copies of the information does not accumulate in a host and a storage system cache as claimed in claim 27. *McIntosh-Smith* discloses a partitioning of a cache (*McIntosh-Smith*, col. 1, line 66 through col. 2, line 3) rather than exclusive caching of a set of information such that the information does not occupy space in both host and storage system caches as claimed in claim 27.

CONCLUSION

Appellant respectfully submits that the stated rejections cannot be maintained in view of the arguments set forth above. Appellant respectfully submits that all of the claims 20-38 are patentable under 35 U.S.C. §§102,103 over the references cited by the Examiner and requests that the Board of Patent Appeals and Interferences direct allowance of the rejected claims.

Respectfully submitted,

By

Date: 6-29-04



Paul H. Horstmann
Reg. No. 36,167

APPENDIX

20. A method for exclusive caching between a storage system cache of a storage system and a host cache of a host system, comprising the steps of:
- providing the host system with access to the information by reading the information from the storage system cache and then storing the information in the host cache and evicting the information from the storage system cache such that the information does not occupy space in both the host and storage system caches;
 - demoting the information from the host cache to the storage system cache if the information is clean when evicted from the host cache such that the information does not occupy space in both the host and storage system caches;
21. The method of claim 20, wherein the step of demoting comprises the step of transferring the information to the storage system cache in a demoted data block.
22. The method of claim 20, wherein the step of demoting comprises the step of storing the information in any free area of the storage system cache.
23. The method of claim 20, wherein the step of demoting cache comprises the step of storing the information in a predetermined sub-area of the storage system cache.
24. The method of claim 20, wherein the step of demoting includes the step of evicting a data block from the storage system cache.
25. The method of claim 24, wherein the step of evicting includes the step of selecting the data block for eviction from the storage system cache from among a set of unshared data blocks in the storage system cache.

26. The method of claim 24, wherein the step of evicting includes the step of selecting the data block for eviction from the storage system cache using a shared status of the data block as a factor in a replacement policy.

27. A computer system, comprising:

storage system having a storage media and a storage system cache;
host system having a host cache;

means for exclusively caching a set of information obtained from the storage media such that the information is stored either in the host cache or the storage system cache but not both caches at the same time wherein the means for exclusively caching includes means for reading the information from the storage system cache and then storing the information in the host cache and evicting the information from the storage system cache and means for demoting the information from the host cache to the storage system cache if the information is clean when evicted from the host cache.

28. The computer system of claim 27, wherein the means for demoting comprises means for transferring the information to the storage system cache in a demoted data block via a communication path between the host system and the storage system.

29. The computer system of claim 27, wherein the means for demoting comprises means for storing the information in any free area of the storage system cache.

30. The computer system of claim 27, wherein the means for demoting comprises means for storing the information in a predetermined sub-area of the storage system cache.

31. The computer system of claim 27, wherein the means for demoting includes means for evicting a data block from the storage system cache.
32. The computer system of claim 31, wherein the means for evicting includes means for selecting the data block for eviction from the storage system cache from among a set of unshared data blocks in the storage system cache.
33. The computer system of claim 31, wherein the means for evicting means for selecting a data block for eviction from the storage system cache using a shared status of the data block as a factor in a replacement policy.
34. The computer system of claim 27, wherein the storage system cache includes a sub-area for exclusive caching and a sub-area holding other cached information.
35. The computer system of claim 34, wherein the other cached information is obtained by performing read-ahead operations from the storage media.
36. The computer system of claim 27, further comprising means for transferring the information evicted from the host cache to the storage system in a write operation if the information is dirty.
37. The computer system of claim 27, wherein the host cache is a RAM cache.
38. The computer system of claim 27, wherein the host cache is a disk cache.